

# Spin-echo Resolved Grazing Incidence Scattering

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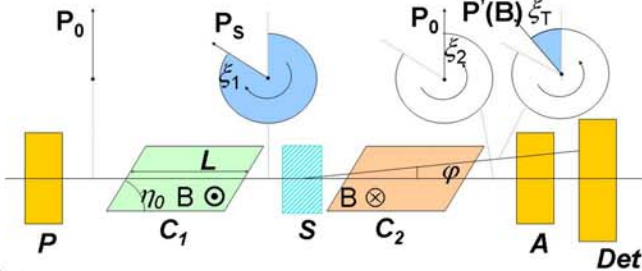
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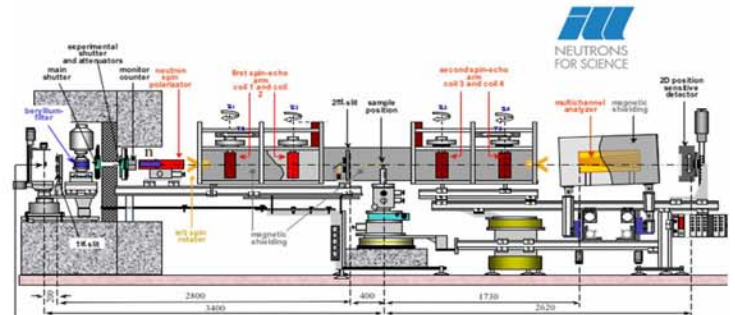
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## Motivation

- The observation by scattering techniques of large scale density fluctuations requires collimation of the incident or scattered beam and consequent loss of neutrons.
- Spin-echo can be used to encode directly (without collimation) the scattering vector of neutrons in transmission geometry or at grazing incidence.



## EVA transformed into a SERGIS prototype instrument

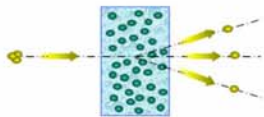


We tested the idea after modifying the EVA reflectometer at the Institut-Langevin, in Grenoble. Neutron resonance spin-echo coils were inserted between the polarizing mirror and the sample and between the sample and the analyzing mirror.

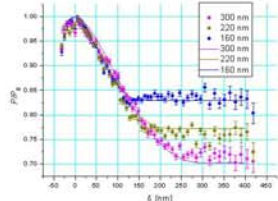
## Experiments in transmission geometry

### Polystyrene Spheres

2.5% in 3:1 D<sub>2</sub>O/H<sub>2</sub>O, 2mm thick cell



From spin-echo analysis of the total scattering we obtained the self-correlation of polystyrene spheres suspended in water.

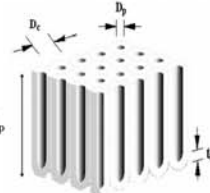


### Anodized Aluminum Oxide

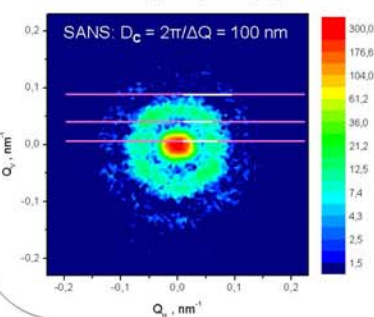
Spin-echo analysis of the 2D diffraction pattern

D<sub>c</sub> ~ 120 nm l<sub>p</sub> ~ 30 nm

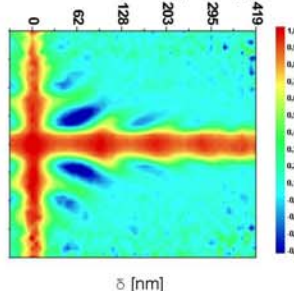
(collaboration: Tao Xu, ANL)



Intensity map ~ S(Q)



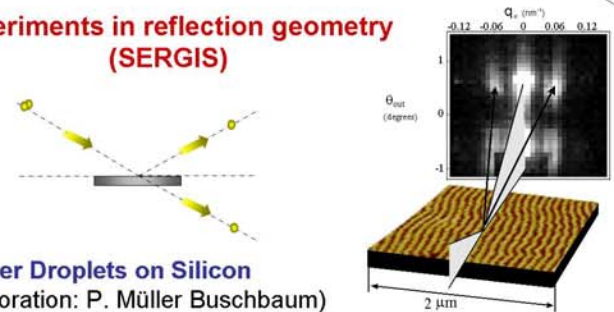
Polarization map ~ G(y)



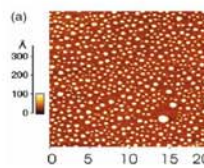
## Experiments in reflection geometry (SERGIS)

### Polymer Droplets on Silicon

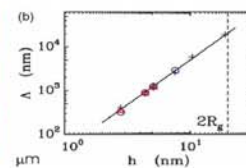
(collaboration: P. Müller Buschbaum)



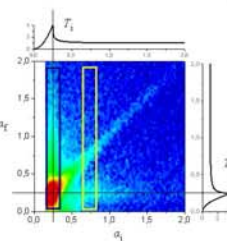
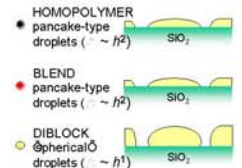
AFM image



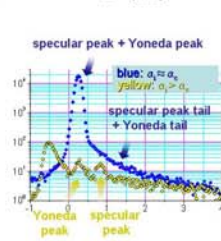
height vs. diameter



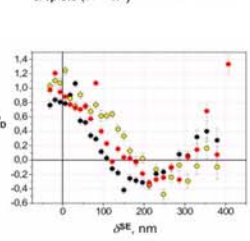
samples tested



Diffuse scattering within the reflection plane



Separating diffuse from specular reflection for spin-echo analysis



Correlation between droplets from spin-echo analysis

## Examples of the science enabled by SERGIS

- The working of artificial bio-membranes
- Structure of de-wetted polymers and adhesive polymers
- Lateral correlation of block copolymers
- Structure of liquid crystals

## Roadmap for the future

- Test of new spin-echo components
- Expansion of the scientific opportunities of SERGIS
- Design of a SERGIS line at the Spallation Neutron Source